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GEOPHYSICAL ABSTRACTS

NO. IV

BY

FREDERICK W. LEE

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DEPARTMENT OF COMMERCE -- BUREAU OF MINES

GEOPHYSICAL ABSTRACTS [1]

No. 4

Compiled by Frederick W. Lee [2]

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1 - GRAVITATIONAL METHODS

DIE GENAUIGKEIT DER MIT DER EÖTVÖS-SCHEN DREHWAGE DURCHGEFÜHRTEN RELATIVEN SCHWERKRAFTMESSUNGEN

(The Accuracy of Relative Gravity Measurements with Eötvös Torsion Balance

By Karl Oltay

Geodätische Arbeiten der Baron R. V. Eötvös-schen Geophysischen Forschungen III, Budapest, 1928.

A series of 15 stations beginning with Potsdam and Budapest and ending with Budapest and Potsdam were occupied in the period August, 1908, to January, 1909. The intermediate stations were all at points which had been connected by Baron Eötvös with torsion-balance traverses. The observations were made with an invariable pendulum of the standard four-pendulum type of instrument of the Geodetic Institute, made by Stückrath at Berlin-Friedenau. The observations at each of the field stations lasted one to three days with one exception; two or three time determinations were made; four to eight series of pendulum observations were made; the error of determination of the elevation of the instrument above mean sea level ranged from 0.30 meter to 1.10 meters, with the exception of the Arad and Baja stations, where the elevation was known more accurately and averaged about ± 0.8 m, which would cause an error of ± 0.25 x 10^{-3} dynes. No topographic correction was applied. The values for △ g were taken from Eötvös: Report on Geodetic Observations in Hungary, especially Observations with the Torsion Balance, Budapest, 1910. The differences in △g as determined by the torsion balance and by the unvariable pendulum were: Kuvin-Hidegkut 12 km.0.001 Livada-Kuvin 9 km.0.001, Pankota-Livada 13 km.0.004, Kuvin-Arad 20 km.0.000, Pankota-Arad via Kuvin 42 km.0.005, Pankota-Arad via Kurtics 50 km.0.000 dynes.

Oltay concludes that if the stations are close enough together and if the terrane is rather flat, the measurement of △g with the Eötvös torsion balance is as accurate as with the invariable pendulum. -- Donald C. Barton.

GRAPHICAL METHODS OF CALCULATION IN INTERPRETATION IN WORK WITH THE TORSION BALANCE; A DISCUSSION OF C. A. HEILAND'S A NEW GRAPHICAL METHOD FOR TORSION BALANCE TOPOGRAPHIC CORRECTIONS AND INTERPRETATIONS.

By Donald C. Barton

Bull. Am. Assoc. Petrol. Geol., vol. 13, No. 4, Apr., 1929, pp. 388-391.

A table is given showing the percentage error in the calculated gradient or differential curvature produced by an error of 10 or 20 per cent in the assumption of prisms at right angles to the cross section. That error in the case of a 10 per cent error in the assumption of the length in general, and in case of a 20 per cent error in many cases, is less than the probable error of field observations. The assumptions in regard to length at right angles to the section need to be only approximate, and the line of section need be only approximately an axis of symmetry. Graphs of that type are applicable to a wide range of geologic structures and where applicable are faster and easier to use than graphs based on cylindrical or spherical coordinates. -- Donald C. Bartin.

C. A. Heiland in reply to D. C. Barton's discussion of his paper: Bull. Am. Assoc. Petrol. Geol., vol. 13, No. 4, Apr. 1929, pp. 391-393.

The writer stresses the universal applicability of his method for the calculation of terrane corrections or of gradient and differential curvature on asymmetric structures or at any point on a symmetric structure and states that the time required to use his method is not as great as Barton concludes, but agrees with Barton that the latter's method is easier for stations on axes of symmetry. -- Donald C. Barton.

GRAPHICAL TERRANE CORRECTION FOR GRAVITY GRADIENT

By Donald C. Barton

Tech. Paper 444, Bureau of Mines, 1929, 12 pp., 6 figs.

The terrane around the instrument is divided into octants and into zones bounded by circles of 5, 10, 20, 40 ..... 640 by 2^n radius. On each zone a pile of blocks is visualized as built up with the vertical thickness of each block so calculated that the block will produce a gradient of 0.1E at the origin. A graphic chart is constructed to represent the cross section of these blocks along the axis of an octant. To permit a convenient-sized chart to represent considerable horizontal and vertical distance, the position of the 5 by 2^n lines of distance and of 0.5 by 2^n lines of elevation are plotted logarithmically, although the intermediate spacing is linear. The elevation of the topography is determined at distances of 5, 10, 20 ..... 5 by 2^n for each octant; the points are plotted on the graphic chart, and the gradient effect of the topography is then read from the chart by adding up the number of squares. As the origin is taken at the center of gravity of the instrument, the graphic chart within a certain range is independent of the height of the center of gravity of the instrument above the ground. -- Author's abstract.

RELATIVE SCHWEREKRAFT-MESSUNGEN NACH DER REFERENZMETHODE MIT DRAHTLOSEV FERNSTEUERUNG DER KOINZIDENZE-APPARATE. (MEASUREMENTS OF RELATIVE GRAVITY BY THE REFERENCE METHOD WITH USE OF WIRELESS CONTROL OF THE COINCIDENCE APPARATUS.)

By Ernst Berger and Karl Mader

Gerland's Beitrage zur Geophysic, Band 21, Heft 4, 1929,
pps. 355-365.

An apparatus is described which makes use of wireless control of the coincidence apparatus as well as of the recording chronographs. The wireless control is given by the second swings of one astronomical clock common to all stations and therefore makes possible a synchronous drive of the coincidence apparatus at all the stations, whereby very exact measurements of relative gravity can be made at outlying stations.

The results of the first observations with the apparatus, for the determination of relative gravity between Laxenburg and Vienna, are given. -- Donald C. Barton.

THE GRAVITY GRADIOMETER

By H. Shaw and E. Lancaster Jones

The Mining Magazine, vol. 40, No. 5, May, 1929, pps. 272-279.

The gradiometer is a radical innovation in the Eötvös balance. A three-armed beam carries two lower weights (instead of the conventional one) and a rigid rod supporting the upper weight. The differential curvature is not measured, and observation of the instrument in three azimuths at 120° apart is sufficient mathematically to give the gradient. The beam comes to rest in 20 to 25 minutes. The overall width of the instrument is 7 inches and the overall height 4 feet. The weight of the instrument (including tripod) is 100 pounds. The shelter for the instrument weighs 90 pounds. The instrument is read visually. Its accuracy according to the authors is 1.5 to 2E. In a 24-hour test stations were occupied. -- Donald C. Barton.

ÜBER MESSUNGEN MIT DER GLEICHMÄSSIG GEDREHTEN DREHWAGE UND EIN NEUES RECHENVERFAHREN

(MEASUREMENTS WITH A TORSION BALANCE ROTATED UNIFORMLY AND A NEW METHOD OF CALCULATION)

By Karl Kilchling

Ztschr. für Geophysik, Jahrg. 6, 1927, pp. 281-285.

A statement is given on the experiments of measurements accomplished by a torsion balance rotated uniformly, as well as on very simple and quick method of calculations for the evaluation of the curve obtained.

As an arrangement of the Eötvös torsion balance for a uniform rotation was difficult, the box of the balance, instead of resting on a foot, was suspended at a steel wire, and the rotation was obtained by means of clockwork provided with a stopping device. The total time of rotation was three hours. Owing to the high moment of inertia of the box of the balance, the rotation proceeded with a satisfactory uniformity, although the disturbances caused by the clock-work could not be avoided entirely.

The measurement at one station only was made but was repeated many times.

The gravity curve obtained is shown in two figures.

The calculations concerning the curve are carried through, and the working out of the data is described.

The time required for the measurement was about two hours. The whole calculation of the gradient and of the directing forces, using the method described, according to the author, takes only ten minutes. -- W. Ayvazoglou.

ZUR FRAGE NACH DER URSACHE VON LOKALEN GRAVIMETRISCHEN UND ERDMAGNETISCHEN STÖRUNGEN UND IHRE WECHSELSEITIGEN BEZIEHUNGEN

(CONCERNING THE QUESTION OF THE REASONS FOR THE LOCAL GRAVIMETRIC AND EARTH-MAGNETIC DISTURBANCES AND THEIR MUTUAL RELATION.)

By H. Haalck

Ztschr. für Geophysik, Jahrg. 4, 1928, Braunschweig,
pp. 209-219 and 263-272.

The article is divided by the author into two chapters:

Chapter I, "Diagrams as a means of aid in the interpretation of the pictures obtained by torsion-balance measurements."--

Diagrams are given by the aid of which the influence of the difference in density of the underground bodies upon the second differential quotients of the potential of the force of gravity can be established.

Practical use of the diagrams is shown in an example and the application of them for interpretation of pictures obtained by torsion-balance measurements is explained. The theoretical relations to the corresponding diagrams of the local earth-magnetic anomalies, as well as explanation of some practical examples, are given in the second chapter:

Chapter II, "Theoretical relations between the torsion balance measurements and earth-magnetic measurements; diagrams as a means of aid in the interpretation of the local earth-magnetic disturbances."--

Here the author examines briefly the theoretical relations between the disturbances of the force of gravity and the local earth-magnetic disturbances and shows how the diagrams which serve for the establishment of the influence of mass inequalities of any form upon the torsion balance can be used on the influence of these masses upon the earth-magnetic force components. Practical application of the diagrams is given in an example. -- W. Ayvazoglou.

EIN GRAPHISCHES VERFAHREN FÜR DREHWAGENMESSUNGEN ZUR BERECHNUNG DER GELÄNDEWIRKUNG UND DER WIRKUNG BELIEBIG GESTALTETER MASSENKÖRPER

(GRAPHICAL PROCEEDING OF TORSION-BALANCE MEASUREMENTS FOR THE CALCULATION OF THE TERRAIN INFLUENCE AND OF THE INFLUENCE OF LARGE BODIES OF ANY FORM)

By H. Haalck

Ztschr. für Geophysik, Jahrg. 4, 1928, pp. 161-178.

In order to be useful in practice the graphic proceeding of torsion-balance measurements for the establishment of terrain corrections must, according to the author, answer, as far as possible to the following requirements:

1. Be of a sufficient accuracy, either on a level or intersected terrain;
2. Shall not be restricted to any certain levelling operation;
3. Shall not depend on a certain height of the position of the torsion balance above the surface of the earth;
4. Must be simple in manipulation in using diagrams and formulas.

In the article a simple process is described which might be convenient for torsion balance measurements on any terrain and at any height of the instrument above the surface of the earth. Its practical application is explained by an example. The method is suitable also for a simple calculation of the influence of large bodies of any shape on the torsion balance.

The article is provided with tables and diagrams. -- W. Ayvazoglou.

2 - MAGNETIC METHODS

MAGNETISCHE MESSUNGEN IM ÖSTLICHEN RIESENGEBRIGE

(MAGNETIC MEASUREMENTS IN THE EASTERN RIESENGEBIRGE

By Gerhard Meyer

Abhandlungen der preussischen geologischen Landesanstalt,
Heft 105, Berlin, 1927, 53 pp.

Contents of the pamphlet:

1. Bibliography;
2. Introduction;

3. Instrumental and physical part;

4. Analysis of the results of measurements;

5. Geological interpretation of the results of measurements;

6. Remarks to Map I (scale 1:100000)

7. Remarks to Map II (scale 1:25000)

8. Table I. Examination of crystalline slate of the eastern Riesengebirge concerning its magnetic peculiarities;

9. Table II. List of surveyed stations;

10. Table III. List of stations at which additional magnets were used for measurements;

11. Table IV. Repeated measurements;

12. Table V. List of surveyed stations arranged numerically.

The results of the measurements accomplished by the author in September, 1926, in the Riesengebirge with the purpose of studying the magnetic behavior of granite blocks with regard to the zone adjoining them are examined. Three hundred and eighty-two measurements were made at 264 stations. The distance between the stations was about 2 km. in the region of the granite deposit. In the zones adjoining the granite this distance was reduced to about 150 meters.

Preparatory work as well as the evaluation of the results was accomplished under the direction of Dr. H. Reich.

Schmidt's local variometer, manufactured by Askania Werke, was used for the measurements of the vertical intensity.

Tables and maps have been compiled with great accuracy. Based on the data collected by the magnetic measurements in the Eastern Riesengebirge the author concludes that the very important indications on the structure of the subsoil obtained by magnetic measurement have proved again to be very useful in drawing geological maps. The magnetic research of the vertical intensity with the variometer can be accomplished easily so that already during the work in the field the difference in the magnetization of various rocks may be established. Thus the great anomalies of the quartz-amphibolites to the south of Adlersruh, the lenses of feldspath-amphibolites at stations 237 and 164, as well as the Schmiedeberg ore area could be established by the measurements already during the field work.

The representation of the Z-isonomalies made it possible to mark the boundary lines of the granite area formed with the crystalline slate of the amphibolite group adjoining this area on the east.

Accurate data on the geological conditions of the green-slate areas to the north of the main deposit could not be obtained owing to the too great distances between the stations, but a considerable difference of the weakly magnetized green-slate and strongly magnetized amphibolite slates was established nevertheless. -- W. Ayvazoglou.

ZUR FRAGE DER REGIONALEN MAGNETISCHEN ANOMALIEN DEUTSCHLANDS, INSBESONDERE DERJENIGEN NORDDEUTSCHLANDS

(REGIONAL MAGNETIC ANOMALIES IN GERMANY, ESPECIALLY THOSE IN NORTH GERMANY)

By H. Reich

Ztschr. für Geophysik, Jahrg. 4, 1928, Braunschweig, pp. 84-100.

About 2,000 measurements of magnetic vertical intensity, at 1,360 stations, were made by the author in the different parts of northern Germany during the last five years; Schmidt's magnetic field balance was used. The main regional magnetic anomalies were established. The probable geological reasons are discussed and conclusions are drawn based on comparison with other similar anomalies, the causes of which are known.

Great disturbances (especially positive anomalies) were found to be in areas with eruptive rocks and crystalline slates. The positive anomalies of the parts of north Germany covered with diluvium can probably be explained also by the influence of the eruptive rocks deposited at greater depths. Areas with great sedimentary masses were indicated by negative anomalies.

Maps showing the values of horizontal anomalies in several areas in Germany, some of them prepared by the author himself, are added to the article.

Although a brief description of the magnetic anomalies in North-Germany has already been published by Reich in the "Zeitschrift der deutschen geologischen Gesellschaft" (Jahrg 79, 1927, pp. 325-339), the author promises to publish more details after the material already obtained is ordered, and some additional field work accomplished. The work will appear in the "Abhandlungen der preussischen geologischen Landesanstalt". -- W. Ayvazoglou.

BEMERKUNGEN ZUR DEN MAGNETISCHEN VERMESSUNGEN DES GEBIETES ZWISCHEN ZALZGITTERER HÖAEBZUG UND OBERWALDSATTEL DURCH E. KOHL UND R. KRAHMANN

(REMARKS ON THE MAGNETIC MEASUREMENTS MADE BY E. KOHL AND R. KRAHMANN ON THE TERRITORY BETWEEN THE ZALZGITTERER MOUNTAIN CHAIN AND THE OBERWALD SADDLE)

By H. Hunkel

Metall und Erz, Jahrg. 25, Heft 22, 1928, pp. 571-582.

The following articles of E. Kohl and R. Krahmann are discussed in the present paper:

1. Beträge zur erdmagnetischen Erforschung Norddeutschlands (Contributions to the earth-magnetic researches made in Northern Germany), by E. Kohl, Jahrbuch der preussischen geologischen Landesanstalt, 1928, pp. 124-137.

2. Über geoelektrische und magnetische Untersuchungen (on geoelectric and magnetic researches), by R. Krahmann, Metall und Erz, Jahrg. 23, 1926, pp. 583-586.

Summarizing the above articles of Kohl and Krahmann, with the help of two diagrams given in those articles, one showing the "magnetic and geological profile between the Zalzgitterer mountain chain and the Oberwald saddle", represented by E. Kohl, and the other the "Magnetic experimental measurements made over the salt domes and iron ore in Zalzgitter and Flachstöckheim," by R. Krahmann, Hunkel states that the interpretation of the magnetic measurements in the Zalaitterer mountain chain published by Kohl must be considered to be inconclusive and that the measurements accomplished by Krahmann in the same region, proved to be entirely useless. Hunkel writes:

"E. Kohl examines his profile measurements taken between the Zalzgitterer mountain chain and the Oderwald saddle, as usual, by comparing them with the geological profile and assigns to the rocks various 'positive' and 'negative' effects of disturbances with regard to the mean magnetic value of the terrain in question. The purpose of the present article is to show that Kohl's interpretation is neither sufficient nor free from contradictions, and that neither the Trias, Jurassic, and chalk layers, nor the Zechstein salt have evidently influenced the magnetic field on the surface of the earth, but that only the existence and the position of the brown hematite vein between the Jurassic and chalk layers are responsible for the course of the magnetic curve given by Kohl. Therefore an interpretation of the magnetic measurements, which is in itself, as well as with regard to the geological profile, entirely correct and complete without any tectonic hypothesis, is possible.

"The parallel profiles measured by R. Krahmann independent of Kohl contain so many measurement errors that an interpretation of them is useless. Therefore the interpretation given by Krahmann may be considered to be an arbitrary explanation based on the known geological profiles, which, as shown by the comparison with the above-mentioned interpretation of Kohl's profile, are besides not correct."

Hunkel's article naturally worked replies from both Kohl and Krahmann. A detailed answer on all the points of the dispute, illustrated by diagrams, is given by Krahmann.

The answers as well as the final conclusion made by Hunkel are published in the same paper. — W. Ayvazoglou.

3 - SEISMIC METHODS

A SEISMIC METHOD OF DETERMINING THE DEVIATION OF DULL HOLES

By Mark C. Malamphy

The Oil Weekly, vol. 53, No. 6, April 26, 1929, pp. 31-32, 70-80.

The position of the bottom of a well may be determined by dropping the detector of an electric-type seismograph to the bottom of the well and exploding small charges of dynamite at a certain pattern of locations. Formulas for the computation of the position of the bottom of the hole from the results are given. The charges of dynamite required are small, and the time necessary to make the survey is less than a day. The cost of the determination is low. The greatest difficulty will be in applying the method in an area where the beds dip steeply.

The use of several detectors suspended at different depths will allow simultaneous determination of position of well hole at as many points. No mention is made of the actual application of this method by the Geophysical Research Corporation. -- D. C. Barton.

FACTORS IN DESIGN OF PORTABLE FIELD SEISMOGRAPHS

By Mark C.Malamphy

The Oil Weekly, vol. 53, No. 1, Mar. 22, 1929, pp. 28-30, 84-94.

Field seismographs are of two types, "mechanical" seismographs in which there is mechanical magnification of the movement of the heavy mass, and "electric" seismographs in which the movement of the heavy mass is transformed into an electrical impulse which is then amplified. The following factors in the design of the seismograph equipment are discussed: Weight of equipment including carrying cases, over-all dimensions, transportation equipment, sensitivity (amplication) of seismograph, frequency (selectivity) characteristics, damping of recording apparatus, timing system, simplicity of adjustments and operation, sensitivity of seismograph or blastophone to sound and receive air waves, accessibility of all instruments for adjustment repair or replacement of parts, provision for development of records in the field, method of transmitting the exact instant of the shot, radio equipment, and power supply for electrical equipment.

This is an interesting and reliable account of many details of the art of seismic prospecting. -- Donald C. Barton.

SEISMIC METHODS IN GEOPHYSICS

By A. O. Rankine

The Mining Magazine, vol. 40, No. 5, May, 1929, pp. 311-314.

Abstracts from a paper by the author are appended to give a condensed rather mathematical explanation of the seismic method of prospecting. -- D. C. Barton.

4 - ELECTRICAL METHODS

GEOPHYSIKALISCHE SCHÜRFUNGEN AUF ERDÖL

(GEOPHYSICAL PROSPECTING FOR OIL)

By Norbert Gella

Ztschr. fur praktische Geologie, April, 1928, pp. 49-54.

The author points out the importance of geophysical methods of oil prospecting by which much time and money are saved.

After a brief historical review of oil prospecting on the Gulf coast in Texas and Louisiana by means of borings, which in most instances were of uncertain character although the expenses were enormous, Gella mentions the discoveries of oil by modern geophysical methods (seismic and torsion-balance measurements).

Based on the good results obtained already in finding ore deposits by electric methods of prospecting Gella recommends this method also for oil prospecting.

The property of oil of being a bad conductor makes determination of its position possible by drawing current line pictures.

Gella recommends carrying out a testing program by establishing sending stations, investigating the terrain, and obtaining, at a number of points, data on the horizontal and vertical components of the magnetic field, graphical representation of the data, and comparison of the picture with that obtained for a normal field (on a homogeneous ground).

The author cites examples of oil prospecting in Texas by electric methods, by which areas not containing oil could be determined, thus saving the money necessary for test holes and of determination of the direction of oil sands from NE. to SW, and not from W. to E, as has been expected before.

The exact establishment of salt dome borders in two tests in Texas and Louisiana at a depth of 600 to 800 feet has proved the importance of the electric method of oil prospecting.

Experiments made in Germany must also be considered to be very satisfactory as, although no oil was found, the absence of it was established with surety; thus the uselessness of drilling was proved and saving of large sums of money reached. -- W. Ayvazoglou.

DIE BESTANDTEILE DES MAGNETISCHEN FELDES BEI GEOPHYSIKALISCHEN BODENUNTERSUCHUNGEN MIT WECHSELSTROM UND SEINE BEEINFLUSSUNG DURCH LEITENDE EINLAGERUNGEN

(THE ELEMENTS OF THE MAGNETIC FIELD IN GEOPHYSICAL RESEARCHES PERFORMED BY MEANS OF THE ALTERNATING CURRENT AND THE INFLUENCE UPON IT OF DEPOSITS OF GOOD CONDUCTIVITY)

By W. Heine

Ztschr. für Geophysik, Jahrg. vol. 6, 1927, pp. 293-307
(with 17 diagrams).

The magnetic field produced by alternating current flowing into a homogeneous ground as well as into deposits of different conductivity is calculated under simplified assumptions, the admissibility of which is discussed.

Curves of the change of the angles of inclination of the magnetic vectors at the crossing of an ore vein are drawn for a series of examples, according to the formulas obtained; two measurements taken on the terrain are compared.

The magnetic vector at any point of the area under investigation can be supposed to be composed of the following three elements: (1) The magnetic field of the line; (2) the magnetic field of the current flowing into a stratum of good conductivity, and (3) the field of the current which flows in an undisturbed and electrically homogeneous ground without being influenced by the deposits.

Heine calculates these three elements under simplified assumptions and gives diagrams of curves showing the angles of inclination of the magnetic vectors, neglecting the phase relation, as well as the influence of the current induced in the ground by the line.

The induced electric eddy-current field produced by an alternating current flowing through the wires leading to the electrodes in the ground is examined in the last part of the article. -- W. Ayvaxoglou.

ÜBER DEN ANGEBLICHEN GEOPHYSIKALISCHEN NACHWEIS VAN ZALZDOMEN IM OBERELSASS

(ON THE REPORTED DISCOVERY OF SALT DOMES IN UPPER ALSACE BY GEOPHYSICAL PROSPECTING)

By H. Hunkel

Ztschr. f. d. Kali-und Steinsalzindustrie sowie das Salinenwesen, Nos. 23, 24, 1928, and No. 1, 1929, pp. 366-368; 383-385; 7-10.

The purpose of the two examples published in the articles is to show that the geophysical prospecting method, accomplished by the "Société de Prospection Electrique (Schlumberger Method) à Paris", which is called "Electric boring" and consists of the deduction of the specific resistance of the underground bodies situated at any depth, from the potential measurements made on the surface of the earth, against which, of course, certain theoretical doubts exist, did not prove to be in satisfactory conformity with the expected resistance constants obtained from the actual results of boring.

This method was further used in the Rhintalgraben near Ensisheim; and a picture of curves of equal resistancy for a certain depth, not fixed exactly, was drawn, based on the potential measurements on the surface of the earth from which the existence and position of a salt dome in the Rhintalgraben was deduced, which as a matter of fact is a geological novum. The article shows that the analogy between the curves of equal resistances and the topography of the salt mountains in Rhintalgraben, as established and used by Schlumberger, is entirely inconclusive and that neither a salt dome nor even the existence of salt in any form can be deduced from Schlumberger's resistance curves. Therefore Schlumberger's electric measurements can not be considered in any way as an avidence of the existence of salt domes in Upper Alsace. But with the aid of another definition of Schlumberger's curves, it is possible to put the electric measurements into perfect harmony concerning all the details in connection with the tectonic of broken soil of this area and to establish the fact that the cracks, especially of highly elevated soil, are the main reasons of the Schlumberger's curve picture.

With the aid of intensive electric measurements according to a suitable procedure, as well as by the aid of a new theory concerning them, mentioned above, further understanding of the tectonic of broken soils on the Upper Rhine and the search for salt domes, especially those of small depth, promises good success.

The following supplement concerning the same question is given by the author:

When the above mentioned articles were printed another publication of C. and M. Schlumberger on the discovery of a second "salt dome" 2 kilometers east of Hettenschlag in Upper Alsace in a strict prolongation of the Meienheimer dome was received.

The representation of the electric measurements is, of course, not added to the brief description. Here Schlumberger insists again that the curves of equal resistances derived from the measurements answer the approximate circumference of the salt dome, which became perceptible owing to a "considerable local reducing of the resistance". As the specific resistance of alluviums is between 300 and 400 ohms per cubic meter, and that of marl between 10 and 20 ohms, Schlumberger deduces that the resistance minimum is due to the fact that over the "salt dome" there are probably layers of marl of good conductivity which mount up over the salt at about 10 meters below the surface of the earth, as proved by drilling by which the salt was reached at a depth of 100 meters. (It seems that here one of the borings mentioned in the previous articles is concerned). As I have proved above, the values of the electric resistance along the boring cannot be brought into connection with the values of the resistances expected according to the boring profile.

A series of remarks by Schlumberger in his latest statement makes me believe that the method of the definition of resistances at any depth by means of potential measurements at the surface of the earth can not be based on an exact foundation. The new "salt dome" is evidently a high elevated dome between two transverse cracks of the prolonged Meienheimer dome, and the electric indication may be explained in the same way as above by the influence of the prolongation of the large crack by which the Meienheimer dome is limited on the west. -- Author's abstract.

ZUR STREITFRAGE DER DIREKTEN AUFFINDUNG VON ERDÖLLAGERSTÄTTEN MIT HILFE ELEKTRISCHER VERFAHREN

(THE DEBATED QUESTION OF THE DIRECT DISCOVERY OF OIL DEPOSITS WITH THE AID OF ELECTRICAL METHODS OF PROSPECTING)

By H. Hunkel

Petrol. Ztschr. Jahrg. 25, Bd. 10, 1928, Berlin, pp. 293-3081

Geophysical prospecting for oil deposits based on bad electric conductivity of oil, by using electric methods, have led to a contradictory opinion on the possibility of direct discovery. The possibility of the direct discovery of oil is denied by some geophysicists (R. Ambronn, K. Sundberg), while another group (N. Gella, J. Koenigsberger, R. Krahmann) is of the opposite opinion, supporting it by theoretical conclusions, as well as by publication of the results of their investigations.

Hunkel sums up his article as follows:

"R. Ambronn's argumentation by which he denies the possibility of a direct discovery of oil deposits by means of electrical prospecting is untenable owing to several reasons.

"J. Koenigsberger's attempt to prove this possibility theoretically, results in a series of statements only.

"It can rather be shown that the electric disturbances caused by the underground deposits of good or poor conductivity are very different and that no perceptible effects can be produced on the surface of the earth by oil horizons under the usual natural conditions and the sensitiveness of the present time measurement instruments. Therefore the experimental researches published as a proof of the possibility of a direct discovery of oil by electric methods of prospecting, as well as the interpretation of the data of these researches, must be considered a failure.

"These publications, even without taking into consideration the theoretical conclusions, may be considered to be either insignificant or proving just the contrary of that which they try to prove.

"The anomalies in the movement of the current observed, as shown in the examples mentioned, can easily be explained by the presence underground of bodies with better electric conductivity.

Hunkel's article provoked polemics between him and N. Gella, which are published in the same number of the Petroleum Zeitschrift, and, being of a critical nature, are very interesting as they may serve to throw light in general on the question discussed. -- W. Ayvazoglou.

EIN QUANTITATIVES ELEKTROMAGNETISCHES MESSVERFAHREN ZUR BESTIMMUNG DER TIEFE UND DES EINFALLENS VON ERZGÄNGEN VON DER OBERFLÄCHE AUS

(THE QUANTITATIVE ELECTROMAGNETIC PROCEEDING OF MEASUREMENTS FOR THE DETERMINATION, FROM THE SURFACE OF THE EARTH, OF THE DEPTH AND DIP OF ORE LODES)

By Max Müller

Gerland Beiträge zur Geophysik, Bd. 21, Heft 2/3, 1929, Leipzig, pp. 234-269.

1. The geological conditions of the examined area are described.

2. An apparatus is described which permits quantitative measurement, free from individual influences, of a magnetic field charged with alternating current interlinked with layers of earth.

3. At Bleialf in the Eifel district three components of the magnetic field vertical to each other were measured above a lode the size of which, at a depth of 95 meters, was at least 10 to 30 centimeters. The curves show distinctive change of intensity in passing over the conducting lode. Further, the inclinations of the magnetic vectors have been ascertained in three planes vertical to each other.

4. The constituents of the magnetic field and its components have been estimated in three directions vertical to each other.

   a. The relative conditions of the distribution of the components of the magnetic field and of the layer charged with current, of its depth, its dip, and its boundaries, have been calculated.

The following criterions were used: The relation of the maxima of the vertical and horizontal components, the distance of the intersecting point of the intensity distribution curves from the maxima, and the inclinations of the magnetic vectors.

Formulas are given for estimating the components of the magnetic field of the current of the current traveling outside of the layer in the semifield in three directions vertical to each other under the consideration of diminishing of the current density in the direction of the depth and the outer zones of the flux field. It is shown that slate may be considered, with regard to electric current, an anisotropic medium. In connection therewith it is shown that in simple cases the tectonic of the underground can be established by means of three components of the magnetic field, vertical to each other.

5. It is shown how the resulting fields may be established by superposition of the various component parts of the magnetic field.

The estimated curves are in an approximate conformity with the measured ones. -- Author's abstract.

SOME PRACTICAL RESULTS OF ELECTRICAL PROSPECTING FOR ORE

By Karl Sundberg and Hans Lundberg

Institution of Mining and Metallurgy, No. 296, May, 1929,
London, pp. 1-18.

(This is a paper discussed at a meeting of the Institution of Mining and Metallurgy held at the rooms of the Geological Society, Burlington House, Piccadilly W., on Thursday, April 18, 1929. Extra copies of this paper may be obtained at a cost of 1 s.od. each, at the Office of the Institution, Cleveland House, 225, City Road, London E.C.I.)

In the first part of the article, "Introduction", the authors give a brief outline on the general problem in electrical prospecting for ore. The procedure of solving this problem comprises two steps, namely:

1. Energization (galvanic and inductive methods);

2. Study of current distribution (investigation of the electric or the magnetic field, mapping of equipotential lines).

A summary of the general classification of electrical prospecting methods is given in Table I.

The second chapter, "Practical Results in Sweden", deals with geophysical prospecting methods used in that country for discovering ore deposits.

A map of Sweden showing the four ore-bearing districts of importance is given. Two of them, that of Northern Lapland or Norrbotten and Central Sweden or Bergsladen, containing both iron and sulphide ores have been known from ancient times, and the electrical prospecting has been used in these districts only recently. The two other ore-bearing districts, the Skellefte district and the Västerbotten Mountains, have been discovered essentially by means of the electrical prospecting in conjunction with geological investigations. They contain sulphide ores almost exclusively.

The description of the districts and the different types of the ore are enumerated, those having commercial value being mentioned especially.

Electrical prospecting has been carried out on a large scale in Västerbotten since 1918, and as a result a new ore district has been discovered.

The names of the new fields, the approximate area of the ore bodies, and the character of the ore are given in Table II. Typical results of electrical work, checked by later drilling, are shown in two figures. Electrical indications and results of drillings made in 1924-1925 in the Boliden ore field are shown on a map. The production has already started, and a smelting plant for Boliden ore is now being erected at Skellefte in Sweden and will be in operation next year. The plan is to mine 120,000 tons of ore each year, which will give 60,000 tons of pyrite with an average of 45 per cent S and 60,000 tons of ore for the smelting plant, which will produce about 1,200 tons of copper, 600 kg. of gold, and later 5,000 tons of arsenic, annually.

In the third chapter, "Prospecting for Molybdenite at Questa, New Mexico", the authors describe the region investigated by electrical methods of prospecting in 1927. Numerous veins are mentioned, the types most frequently represented being:

1. Veins containing molybdenite alone.
2. Veins containing other sulphides with little or no molybdenum.
3. Veins containing limonite and other oxidation products.

A typical example of the electrical results is given, in which are shown in section: the dip of polarization plane, amplitude of the in-phase (real) and parts of the horizontal and vertical field components.

Based on the results obtained by this survey the authors conclude as to the possibility of using electromagnetic prospecting for finding small veins with poor conductivity on an area of very rugged topography.

Chapter IV: "Prospecting in Newfoundland". The area prospected was that of Buchan's mine, about 5 miles north of Red Indian Lake, and in the summer of 1926 valuable ore bodies were discovered by electrical methods of prospecting. The equipotential method was found to be the most applicable, both for reconnaissance survey and for detailed work. In surveying lake areas during the winter electromagnetic methods were used.

The conditions for electrical prospecting were very favorable, as the ore bodies occur in zones of mineralization which are slightly conductive and thus capable of being traced electrically. Two large groups, the "Oriental" and the "Lucky Strike", were discovered.

The ore reserves at Buchan's now amount to 5,750,000 tons with an average assay value of gold 0.33 oz.; silver, 3.25 oz.; copper 1.4 per cent; lead 7.65 per cent; and zinc 17.85 per cent.

After the discovery of Lucky Strike nearly all exploration work was concentrated there. A mill and a power plant were constructed, and a railroad 23 miles long was completed, connecting the mine with the Newfoundland Government railroad.

In conclusion, the authors are of the opinion that the value and usefulness of electrical prospecting have been abundantly proved in this district and that it is doubtful whether these important ore bodies would ever have been located without this method. -- W. Ayvazoglou.

REPORT OF VISIT TO GERMANY DURING THE WINTER OF 1927-28

(In Russian)

By A. Petrowsky

Gorny Journal (Mining Journal) vol. 9, 1928, Moscow, U.S.S.R.,
pp. 694-653.

This is a very interesting report by Professor Petrowsky, director of the electrometric section of the Institute of Practical Geophysics, of his visit to Germany made to obtain information on the following questions:

1. The general status of electrometric methods of prospecting;
2. Instruments used for this prospecting;
3. Theoretical and experimental achievements in this domain;
4. Methods of working out the data of observations obtained;
5. The teaching and literature.

The establishment of personal relations with specialists working in the domain of geophysical prospecting (especially electrical) may be included in the purposes of the visit.

1. Petrowsky mentions the previous defective general conditions of geophysical prospecting and states that public opinion in Germany on the

geophysical prospecting has greatly changed in the last two or three years in favor of this prospecting.

2. A series of new instruments manufactured by different firms in Germany has been examined by Petrowsky and a brief opinion of them is given.

3. Theoretical work is concentrated in Germany mainly in three places: Freiburg - Profs. Königsberger and Jensen; Berlin - Dr. Hummel; and Göttingen, - Dr. Ambronn, who, according to Petrowsky's opinion, all attach great importance to the theoretical work in connection with prospectting in the field.

4. In the domain of the experimental work and working out the data obtained by observation, the Germans have made great progress. Petrowsky visited many firms and laboratories and gives his impressions on the work in them. Large funds are already appropriated and the construction of a new building for the Institute of Oscillations in which not only the Government but also private firms take part has already been started. At the head of this institute will be put Prof. Wagner, president of the Henry Hertz Co.

5. Teaching and books: Lectures on geophysics are already being delivered in the Technical High School at Charlottenburg by Prof. Angenheister, in the University of Leipzig by Prof. Weikman, and in the University of Göttingen by Prof. Zahlfeld. Lectures on geophysical methods of prospecting were to be started in the Freiburg Berg Academy from the autumn of 1928 on. New books are appearing in Germany constantly. Some of them are given special mention in the report. -- W. Ayvazoglou.

5 - RADIOACTIVE METHODS

THE NATURE OF THE PENETRATING RADIATION

By Dr. W. Bothe and Prof. W. Kolhörster

Nature, April 27, 1929, p. 638.

Up to the present the theory that the penetrating radiation consists of short gamma rays has been prevalent chiefly because the large penetrating power these rays possess is associated with radiations of gamma-ray type. Our recent experiments, however, indicate that this radiation is of corpuscular nature.

The experimental arrangement consisted simply of two "tube counters" of the type recently developed by Geiger and Müller (Die Naturwiss. Jahrg. 16, 1928, p. 615) which were placed above one another at some distance apart in a space screened by 6 cm. of lead and 5 cm. of iron.

Each of the counters was connected to an electrometer, and the deflections of the two electrometers, which were due chiefly to the penetrating radiation (Geiger, Physikalische Zeitschrift Jahrg. 29, 1928, p. 839) were registered side by side on a moving film. With this arrangement a considerable number of simultaneous deflections of both instruments was recorded. For small distances between the counters up to about 20 per cent of the total number of deflections of one counter were coincident pairs. This percentage is so great that it must be explained on the basis that coincidences occur if the same corpuscular ray enters both counters. Two hypotheses may be made concerning the origin of this corpuscular radiation. One is that the primary radiation may be of the gamma type and the coincidences are the result of secondary electrons. In this case one would expect the corpuscular rays to be absorbed more easily than the penetrating radiation that caused them. The alternative is that the penetrating radiation is really of corpuscular nature, in which case there should be agreement between the absorption co-efficient of the rays causing the coincident deflections and that directly measured for the penetrating radiation itself.

To distinguish between these alternatives, a block of gold 4.1 cm. thick was placed between the counters, the diminution in the number of coincidences thereby giving a measure of the absorption of the corpuscular rays.

The first attempts were made in a laboratory of the Reichsanstalt, where the thick floors and celings of the rooms above greatly hardened the radiation. There was no definite diminution in the number of coincident pairs under these conditions. The experiment was then repeated on the roof of the building with the lid of the screen removed. Under these conditions the unfiltered radiation from above acted directly on the counters, and a definite diminution in the number of coincidences was observed on introducing the gold block. The observed difference gives. (M/C) Au -. (3.6 _ 0.5) x 10^{-3} for the mass absorption coefficient. This value agrees well with that measured directly for the unfiltered cosmic rays. We conclude from these data that the penetrating radiation is not of gamma but of corpuscular type.

The complete description and discussion of these experiments will appear in the Zeitschrift für Physik. -- The Authors.

SOME DETERMINATIONS OF THE RADIOACTIVITY OF NATURAL GASES IN THE BAKU REGION

(In Russian)

By I. Cherepennikoff

Bull. Inst. Pract. Geophysics, vol. 1, pp. 277-278, 1925.

During an expedition in the vicinity of Baku in December and January, 1924-1925, made for the primary purpose of analyzing natural gases, several determinations of the radioactivity of these gases were carried out at the request of the Institute of Applied Geophysics.

These determinations were made by means of Schmidt's apparatus, calibrated by using a sample containing $3.31.10^{-9}$ grams of radium, or 9.56 Mache units. The gas container had a volume of 2950 c.c.

Four gases issuing from wells and one gas freely issuing on the surface of the earth were investigated. One of the wells was in the Bibi-Eybat region (#5-50, depth 3060 feet); the other three were in the Surachan region (a) #6-08, 1010 feet, (b) #5-33, 2650 feet, (c) #3-57, 1930 feet). The surface gas was taken from the top of the "Bog-Bog" mud volcano near Balachany village. The four gases taken from drillings showed a complete absence of any radioactivity. Indeed the falling of the electrometer leaves was delayed (as compared with readings in air) because the conditions of ionization are different in gases with complicated molecular structure. However, the gas from the mud volcano showed a radioactivity of 0.42 Mache units. One should also note that this gas had to be kept 1.5 hours in a storage container before measurements could be attempted so that the actual radioactivity might be expected to be still larger. This is also due to the fact that graduation of the apparatus was carried out with air and not with a carbohydrate gas. — Translated by D.E. Olshevsky.

7 - UNCLASSIFIED METHODS

ACCOMPLISHMENTS IN THE DOMAIN OF APPLIED GEOPHYSICS

(In Russian)

By P. M. Nikiforov

Science and Technics, 1928, Leningrad, U.S.S.R., pp. 1-23.

Systematic study of the methods of applied geophysics began in the U.S.S.R. only in 1923 after the establishment of the Institute of Applied Geophysics. The literature on this question was scarce at that time, therefore the activity of the institute was directed toward the following three fundamental principles:

1. Theoretical examination of methods based on physical laws;
2. Verification of the theories established in laboratories and construction of intruments necessary for observation;
3. Verification of methods in the fields by sending expeditions to places important with regard to deposits.

Concerning the description of the accomplishments made during the last ten years the author divides the whole material according to the four main methods used in the U.S.S.R.: (1) Magnetiometric, (2) gravimetric, (3) electrical, and (4) radioactive.

1. After a brief description of the magnetometric method of prospecting in general and the work done in the U.S.S.R. since even 1914, Nikoforov mentions the results of the researches in some districts, as well as the instruments used for obtaining these results. According to his statement the researches in the regions of great magnetic anomalies resulted in many cases in the discovery of new deposits of iron ore.

2. The accomplishments in the gravimetric method of prospecting concern the study of theoretical conclusions and interpretation of the data obtained. The results must be considered successful, as the manner of working out the data is at the present time sufficiently simple so that geological maps may be drawn in the field almost at the same time that the observations are made. Instruments used for this method of prospecting were improved, and already in 1924 new instruments of the type of Eötvös torsion balance with photographic registration were constructed.

The instruments built in the U.S.S.R. are portable and simple in operation. Gravimetric data at 3 to 5 stations per day can be taken by these instruments, as compared with only one to two stations possible to be investigated by German instruments.

The new type of the graviometric variometer with short periods constructed by the author (see Geophysical abstracts No. 2, p. 10) makes it possi to obtain data at 10 to 20 stations a day. Diagrams showing to what degree the details of the distribution of the deposits can be established by the gravimetric method are given for comparison with diagrams drawn based on direct investigation.

3. Concerning the electrical method of prospecting, the author mentions especially the importance of the theoretical work accomplished by Prof. A. Petrowsky in this domain.

4. Finally, the accomplishment in the prospecting by using the radioactive method must be considered successful, as the cases in which this kind of prospecting shall be used are established.

The author mentions the names of scientists (Bogoyavlensky, Kirikov) by whom instruments necessary in the radioactive method of prospecting were constructed. -- W. Ayvazoglou.

GEOPHYSICAL SURVEYING

By W. H. Fordham, with discussion by W.R. MacDonald, S. J.
Truscott, H. B. Bateman, D. C. Barton, Arthur
Wade, H. Shaw and A. B. Edge

Jour. Inst. Petrol. Technol. (London), vol. 15, No. 72,
Feb., 1929, pp. 35-80.

This paper is a review of the applied geophysical methods based on Fordham's personal experience and on a survey of the literature. A brief description of the instruments and a brief statement of the elementary theory of the various methods are given. The value of the methods in prospecting for oil is discussed. Estimates of the cost of geophysical surveys are given. A brief selected bibliography is appended. -- Donald C. Barton.

EARLY GEOPHYSICAL PROSPECTING

By William R. Jones

The Mining Magazine, vol. 40, No. 5, May, 1929, pp. 269-272.

This paper gives a historical resume of the British pioneers in early geophysical prospecting. Fox in 1830 and 1842 published papers on the natural electric current connected with ore deposits. Bennets in 1833, Henwood in 1841, and Hunt in 1841 and 1846 investigated natural earth currents in lodes. D'Anbuisson in 1801, von Trebra in 1818, Forbes in 1822, Fox in 1837 investigated geothermal gradients. Mallet was the father of the seismic method of prospecting, with his observations on difference of velocity of different formations and use of explosions to produce elastic earth waves before 1851. Nöggerath in 1846 and J. F. Schmidt in 1858 proved the correctness of Mallet's theories. -- Donald C. Barton.

POTASSIUM

By Agustin Marin

Buletin del Instituto Geologico de Espana, vol. 8, 3d, ser., p. 328-409.

Chapter V of the book deals with geophysical methods of prospecting salt deposits.

General description of the following methods and the principles on which the methods are based are given:

1. Gravitational method--valuable data on deposits may be obtained by establishing, by means of a torsion balance, gravitational anomalies;
2. Magnetic methods--differences in magnetization of ores determined by magnetometers;
3. Electric method--different electric conductivity of the rocks;
4. Seismic method--difference in propagation of elastic waves produced by shocks and their determination by seismographs;
5. Radioactive method--determination of the position of the ore bodies based on radio emanations;
6. Geothermic method--variations in the earth's crust established by thermal measurements.

As the choice of the special method to be applied in each case is difficult, and in most cases even various methods supplementing one other are to be used, the author recommends, based on his experience, that in case of investigations of salt deposits the gravimetric and magnetometric methods should be applied in the first place for the following reasons; Valuable data on the position of the deposit may be obtained, owing to the great difference in density between the sodium and potasium salts and the rocks surrounding them, as well as owing to the great differences in magnetic permeability existing in salt regions.

The seismic and electric methods may in the opinion of the author be useful for the investigation of salt deposits but as these methods are still in the period of studying (1926) they are mentioned briefly only.

In conformity with the preference given to the first two methods, which besides were used for investigation of salt deposits in Catalonia, the author described the methods more precisely.

Details of the Eötvös-Schweydar torsion balance, its adjustment for the field work, operation, calculation of formulas and working out of data are given. Photographic pictures of the balance, diagrams, and tables of data of observations are added.

Nikoforov's new type of gravitational variometer with short periods is mentioned besides.

Schmidt's vertical variometer used for the investigation of potassium deposits in Catlonia, the method of the operation of the apparatus, as well as the method of calculation the data obtained, are described.

In conclusion the author mentions that the tests performed by electric and seismic methods of prospecting in the salt deposits of North Germany for the determination of the constitution and form of these deposits will prove how far these methods may be applied in the future. -- W. Ayvazoglou.

8 - GEOLOGY

SUBJECTS WITHIN AND WITHOUT THE DOMAIN OF GOVERNMENT BUREAU INVESTIGATION

By Allen H. Rogers

Eng. and Min. Jour. vol. 127, No. 17, Apr. 27, 1929, pp. 682-683.

In this letter to the editor of the journal writer stresses the need for more knowledge of the physical characteristics of ores and rocks in the different mining areas rather than for attempted evaluations of competitive geophysical methods. -- Donald C. Barton.

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